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Nuclear Science Abstracts

Vol. 1 No. 4
August 30, 1948

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NUCLEAR SCIENCE ABSTRACTS

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Contents for August 30, 1948

Subject Category	Page
Absorption and Scattering of Radiation	176
Atomic Bombs	176
Atomic Power	177
Biological Effects of Radiation	177
Biology, General	179
Botany, General	183
Chemistry, Analytical	184
Chemistry, General	184
Corrosion and Anti-Corrosion	186
Cosmic Radiation	186
Crystallography	187
Health Protection	189
Instruments	189
Isotopes	191
Metallurgy	191
Neutrons	193
Nuclear Physics - Methods of Measuring	195
Nuclear Properties	197
Nuclear Theory	199
Nuclear Transformation	199
Nucleonics	200
Particle Accelerators	200
Petroleum Industry	201
Physics, General	201
Quantum Mechanics	203
Radioactivity	204
Radiochemistry	206
Radiography	206
Radiotherapy	206
Rare Earths	207
Tracer Applications	210
Tracer Applications, Radioactive	210
Transuranic Elements	213
Uranium	213
X-rays	215

Indices follow page 215

Location List of Atomic Energy Commission Declassified Documents

Document	Abstract No.	Page
AECD-2104	606	179
AECD-2105	650	193
AECD-2106	698	206
AECD-2107	702	207
AECD-2108	607	179
AECD-2109	608	179
AECD-2110	680	201
AECD-2111	643	191
AECD-2112	638	189
AECD-2113	703	207
AECD-2114	609	180
AECD-2115	704	208
AECD-2116	644	191
AECD-2117	673	200
AECD-2118	705	208
AECD-2119	666	197
AECD-2120	632	187
AECD-2121	688	204
AECD-2122	610	180
AECD-2123	618	184
AECD-2124	719	213
AECD-2125	689	204
AECD-2126	659	195
AECD-2127	611	181
AECD-2128	619	184
AECD-2129	612	182
AECD-2130	633	188
AECD-2131	651	193
AECD-2132	602	177
AECD-2133	613	182
AECD-2134	720	213
AECD-2135	620	185
AECD-2136	697	206
AECD-2137	670	199
AECD-2138	652	193
AECD-2139	721	213
AECD-2140	722	214
AECD-2141	723	214

Errata

It was erroneously indicated in Nuclear Science Abstracts, v.1, no. 3, August 1, 1948, that the documents corresponding to the following abstracts were for sale:

Abstract Numbers 419-A, 419-B, 589.

ABSORPTION AND SCATTERING OF RADIATION

595 The Excitation of Nuclei by Electrons, by I. N. Sneddon and B. F. Touschek. Proceedings of the Royal Society 193 A, p. 344-356, July 2, 1948.

The cross-section for the inelastic scattering of electrons by atomic nuclei is calculated assuming the process to arise from the electromagnetic interaction between electrons and protons. For fast electrons scattered by cadmium the cross-section so obtained is in fair agreement with recent experimental estimates. Difficulties, due to the failure of Born's approximation, arise when an attempt is made to apply the theory to the explanation of the electron excitation curves recently observed by Wiedenbeck.

596 On the Application of Heisenberg's Theory of S-Matrix to the Problems of Resonance Scattering and Reactions in Nuclear Physics, by Ning Hu. Physical Review 74, p. 131-140, July 15, 1948.

It is shown that the Heisenberg S-Matrix can have only simple poles and zeros in the complex plane of momentum and energy variables when the range of force is short. This fact is sufficient to determine the disperion formulas in nuclear physics.

597 Scattering of Particles by the Gas in a Synchrotron, by Nelson M. Blanchman and Ernest D. Courant. Physical Review 74, p. 140-144, July 15, 1948.

Successive elastic encounters of a proton with atoms of air in a proton synchrotron may build up a betatron oscillation whose amplitude exceeds the aperture of the vacuum chamber; in this case the particle is lost. The Rutherford scattering formula, suitably cut off at large and small scattering angles, is used to determine the relativistic mass scattering amplitude of this oscillation as a function of the increasing kinetic energy of the particle. It reaches a maximum, when the latter is four times its value at injection. The differential equation is found, which the distribution of amplitudes as a function of path length must obey, and it is solved by use of appropriate boundary conditions for the case in which damping of the oscillations is ignored. The solution makes possible an estimate of the fraction of the original particles which is scattered to the wall. These results are applied to two proposed synchrotrons to determine the air pressures which gives a ten per cent loss of particles.

ATOMIC BOMBS

598 Atom Bomb. Genie Civil 122, p. 173-177, November 15, 1945.

The development of research on atomic energy is reviewed and illustrated descriptions of plants in the U. S. are given. Calculations of the minimum dimensions of atomic bombs and the explosion temperatures are included. A scheme of the construction of an atomic bomb utilizing lithium hydride and heavy water is given.

ATOMIC BOMBS

599 Science at War, by J. G. Crowther and R. Whiddington. London, H. M. Stationery Office, 1947. 185 p.

A section of the book is devoted to the discovery of the atomic bomb and to the release of atomic energy. British contributions to these developments are emphasized.

ATOMIC POWER

600 Industry's Stake in Atomic Energy, by R. Colborn. Chemical Engineering 54, No. 3, p. 96-100, 113, March 1947.

The trend of research in atomic energy is reviewed and consideration is given to the way in which it is being developed for commercial applications and the effect of its progress on industry. The plans and prospects for power generation are mentioned. The production of radioactive isotopes discussed. Government research organizations and industry participation are described.

601 Nuclear Engineering, by E. U. Condon. Electrical Engineering 67, p. 229-232, March 1948.

An explanation of the chain reaction is given and neutron absorption which limits this action is discussed. The function of the moderator in preventing neutron resonance capture by uranium and slowing down neutrons to speeds requisite to further fission are also discussed. The operation of an atomic pile is considered briefly. A four step process for producing plutonium is described. Some of the significant developments which are likely to be made within the next ten years are listed.

BIOLOGICAL EFFECTS OF RADIATION

602 Effect of X Irradiation on the Maturation of the Circulating Reticulocyte, by Evelyn O. Gaston, Edna K. Marks, and Leon O. Jacobson. AECD - 2132 (CH-3870), May 10, 1948, decl. July 22, 1948. 34 p. For publication in NNES.

The time required for the disappearance of the reticulocytes from the blood of normal and X-irradiated rabbits with and without phenylhydrazine or bleeding-induced anemia was studied in vivo and in vitro. In vitro studies were also made on the rate of disappearance of the normal human reticulocyte and the reticulocyte of humans with various diseases.

When studied in vitro, reticulocytes in blood drawn from normal rabbits disappear over a period of 24-48 hours. Reticulocytes from normal rabbits and from rabbits with phenylhydrazine or bleeding-induced anemia have a comparable maturation rate. A dose of 800 r total-body X-radiation does not alter the rate of maturation in samples of blood drawn 3 hours after treatment; the rate is delayed in samples drawn 24 hours after irradiation. Blood from rabbits having induced anemia gives comparable results. In vivo studies also show comparable results.

The reticulocyte maturation time in the blood of normal human subjects ranges between 24-48 hours when studied in vitro. Nitrogen mustard does not alter the maturation rate in patients having polycythemia vera. (This study was made 1 day after the administration of nitrogen mustard.)

BIOLOGICAL EFFECTS OF RADIATION

603 Chemical Breakage of Chromosomes, by C. B. Allsopp and D. G. Catcheside. Nature 161, p. 1011-1012, June 26, 1948.

Darlington and Koller have analysed the close similarity between chemical and radiation-induced breakage of chromosomes, and have rejected the physical target theory of the X-ray phenomenon as propounded by Lea. The author cites various references which indicate that the target theory must be retained as the most satisfactory working hypothesis explaining the breaking of chromosomes by radiation.

604 Chromosome Irregularities Produced by Atomic Irradiation, by Meta S. Brown. Genetics 33, p. 98, January 1948.

Acetocarmine smears were made of the P. M. C. of eleven cotton plants grown from seed exposed to atomic bomb radiation at Bikini during "Operation Crossroads". In four plants quadrivalents were found at metaphase, one plant having two such multivalent associations per nucleus. Three plants were mosaic for normal and altered chromosome constitution. In two of these a chromosome had been lost, producing monosomic tissue, and in the other a quadrivalent was present. In one plant two chromosomes were frequently found as univalents, or paired with a chiasma only. No chromosome abnormalities were detected in four plants, which had 26 pairs of chromosomes, as was true for plants grown from unexposed seed of the same lot. The types of meiotic irregularities found indicate that gamma ray irradiation had produced translocations, loss of chromosomes, and possibly an inversion in the embryonic tissue of the cotton seed. Morphologically no plants showed any deviation from normal, except one plant which was slightly fasciated at an early seedling stage.

605 Chromosome Structural Changes in Tradescantia Microspores Produced by Absorbed Radiophosphorus, by Norman H. Giles. Proceedings of the National Academy of Science 33, p. 283-287, 1947.

Cut T. paludosa inflorescences were inserted in various concentrations of radiophosphorus (from 100 μc/ml to 0.1 μc/ml) for periods of 1 to 9 days. A count was made of cytological changes at the first post-meiotic (microspore) mitosis. The types of aberrations resulting from β-radiations inside the plant were similar to those caused by neutrons and X rays. Their frequency shows an increase with time and correlates with the increase in radioactivity measured with an electroscope. Within 24 hours chromatid aberrations were observed and remained the principle type. Chromatid exchanges occurred with a relatively high frequency. It was not until the fourth day that chromosome breaks were observed. At the highest concentration (100 μc/ml) the frequency of one-hit chromatid aberration types after 24 hours was equivalent to that produced by about 40 r of X rays; the very high breakage rate prevented aberration frequency counts after about 48 hours.

BIOLOGY, GENERAL

606 The Distribution and Excretion of a Soluble Beryllium Compound Using Be^7 as a Tracer, by Roberta Allen, Geraldine Bonner, Arnold Sparks, William Neuman, James K. Scott, and George Kosel. AECD - 2104 (UR-35), June 2, 1948, decl. July 9, 1948. 22 p. For oral presentation; and will also be for publication in Journal of Pharmacology and Experimental Therapeutics.

Beryllium sulphate containing Be^7 was administered to rats, rabbits, and guinea pigs by different routes. Later the animals were dissected and the beryllium content of the organs determined. Following intravenous administration approximately 30% was excreted in the urine, 30% was recovered from bone and 30% in liver. There were wide species variations in the distribution and excretion; and the amount of beryllium administered to the animal affected the distribution and excretion.

607 The Excretion, Retention, Distribution, and Clinical Effects of Strontium^{89} in the Dog. Part II, Statistical Analysis of Excretion and Retention of Strontium^{89} for Individual Dogs, by George Sacher. AECD - 2108 (CH-3866), June 1946, decl. July 19, 1948. 18 p. For publication in NNES.

Excretion data of 17 dogs injected with Sr^{89} were analyzed. Excretion was assumed to conform to the function $\log E_t = \log E_1 + b \log t$, where E_t is the excretion per day at time t, E_1 is the instantaneous excretion at the end of the first day, and b is the slope of the log E versus log t diagram. Values of E_1 and b were estimated for urinary and fecal excretion of individual dogs. Errors of estimate were also computed. A negative correlation ($r=-0.575$) was found between the urinary and fecal excretion slopes of adult dogs. Slopes and intercepts of urinary and fecal excretion lines of beagle pups were lower than those for adult dogs. In the urine-feces correlation and in dependence of excretion parameters on age, the Sr^{89} results paralled the results with plutonium.

The total elimination, ${}_0Q^\infty$, was defined and estimated for individual adult dogs. It was found that on the average more than 90 per cent of the injected Sr^{89} could be accounted for by extrapolation of the excretion line based on observed excretion in the first few weeks after injection. The calculated total elimination of pups, based on the observed excretion behavior, showed at least 40 per cent of the injected Sr^{89} unaccounted for, presumably because of the increase of total-body strontium concomitant with bodily growth.

608 Studies of Porphyrin Metabolism. Part III, the Relation of Erythropoiesis to the Excretion of Coproporphyrin by Dogs and Rabbits, and to the Concentration of Coproporphyrin and Protoporphyrin in Rabbit Erythrocytes, by Samuel Schwartz, Marcia Glickman, Rosie Hunter, and Jean Wallace. AECD - 2109 (CH-3720), November 25, 1946, decl. July 19, 1948. 29 p. For publication in NNES.

Coproporphyrin has been demonstrated, apparently for the first time, in the red blood cells of rabbits. An average concentration of 3.3 micrograms per 100 ml of red blood cells was found in 13 control rabbits. Values as high as 40 micrograms per 100 ml of cells were found in 3 rabbits subjected to repeated bleeding. Reticulocyte counts and red cell protoporphyrin concentrations in these latter rabbits were also appreciably elevated. Studies in which the red blood cells were fractionated to yield an increased percentage of reticulocytes indicated that both coproporphyrin and protoporphyrin are concentrated in the fractions that are richest in reticulocytes. The isomer type of this coproporphyrin has not yet been determined.

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An increase in the excretion of coproporphyrin-I was found in both urine and feces of 2 dogs injected subcutaneously with 40 mg of phenylhydrazine per kg body weight. Two rabbits injected subcutaneously with 15 mg of phenylhydrazine per kg body weight showed an apparent increase in the excretion of total fecal coproporphyrin, but only one of them had a significant increase in urinary coproporphyrin output. Incomplete studies showed no evidence of increased excretion of the type I isomer in the urine of the rabbits. Isomer data on the feces of the rabbits are not available.

In all 4 animals, the phenylhydrazine produced an acute hemolytic reaction as indicated by a rapid fall in blood hemoglobin concentration and by an increased excretion of fecal urobilinogen. The reticulocyte count and coproporphyrin excretion reached peak values about one week after administration of the phenylhydrazine.

609 Estimation of Slow Neutron Dosage in Whole Body Irradiation, by Joseph G. Hoffman. AECD - 2114 (LADC-527), May 24, 1948, decl. July 19, 1948. 22 p. For publication in American Journal of Roentgenology and Radium Therapy.

Approximation formulae are used to compute theoretically the integral doses arising from capture gammas from the reaction $H^1(n,\gamma)H^2$ in the human body. For an integrated slow neutron density of 4×10^{10} neutrons/gm tissue, the whole body dose is 0.95 megm-R. This includes the $N^{14}(n,p)C^{14}$ contribution to the dose.

Experiments on a mock-up of the human body filled with Na^{24} dissolved in water, are described which indicate the validity of the reciprocity theorem between source and absorber. The physical parameters and data from Mayneord's tables on integral doses are shown to apply in the case of the Na^{24} gamma rays. The data are used to approximate the H^1 capture gamma dose which is found to agree with the theoretically computed dose.

The use of induced activities in Na^{24} and Cl^{38} is discussed with reference to the assessment of tolerance doses of slow neutrons. The gamma activities permit the measurement of slow neutron doses which are 35 to 100 times above tolerance levels.

610 Radium Poisoning; a Survey of the Literature Dealing with the Toxicity and Metabolism of Absorbed Radium, by Hannah E. Silberstein. AECD - 2122 (M-1695), May 26, 1945, decl. July 19, 1948. 41 p. Disposition as required for use in research, development, or manufacturing work. Document for sale by AEC.

This report is based upon a detailed survey of literature concerning radium poisoning from 1908 through 1944. Of 17 human fatalities following ingestion of radium mixed usually with meso-thorium described in the literature post-mortem activities were determined in nine; activities ranged from 1.2 to 126 micrograms radium equivalents. Only two were due definitely to radium alone. The actual intake was known in only one case, namely 2800 micrograms of radium taken over a period of 5 years, leading to death about a year later: 73.66 micrograms were retained at death. All showed advanced regeneration type anemia, acute leucopenia, and varying degrees of bone destruction. Six deaths ascribed in the literature to inhalation of radioactive dusts occurred 5 to 15 years after beginning exposure. Dyspnea and lung fibrosis were the predominant signs, but bronchial carcinoma was also present in one case.

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There were only two early reports dealing with acute levels of dosage. One dog received 75 micrograms of radium per kilo body weight, in a single intravenous injection, and died at 14 days. Four groups of experiments with prolonged or intermittant dosage resulted in chronic poisoning.

In four long-standing chronic human cases the coefficients of elimination were 0.002 to 0.005% per day, at which rate it would take 45 years to get rid of half the fixed radium in the body. The amount of radon lost through the lungs depends on the degree of fixation of radium in skeletal tissues and relative ease with which the radon produced can escape into the circulation.

Deposition and distribution of radium in the body is analogous to that of lead and calcium. One early experiment has been said to indicate that at 3 1/2 months after intravenous injection it is still widely distributed throughout the soft tissues, the highest concentrations being in bone marrow and liver, moderately high in lung. Deposition in bone probably continues to take place as long as any radium remains in soft tissues and in the circulation, going especially to regions associated with the most rapid uptake or turnover of calcium.

Seven human cases are known to have carried more than 0.02 and less than 0.5 micrograms of radium in their system for 7 to 25 years without showing any clinical signs of poisoning, yet as little as 1.2 micrograms has been found in a fatal case. Therefore, the Bureau of Standards in 1941 set 0.1 microgram fixed in the body as the maximum level of radium content.

611 Insufflation Studies in Rabbits with Dusts of Uranium Compounds, by Herbert E. Thompson and Luville T. Steadman. AECD - 2127 [M-1984(R)], June 11, 1948, decl. July 21, 1948. 125 p. Informal disposition and for publication in NNES.

In a large series of rabbits, both the responses exhibited by the animal and the fate of the dose were observed following the intratracheal insufflation of a soluble (uranyl nitrate) and an insoluble (U_3O_8) compound. Large (100 mg) and small (5 and 10 mg) doses were given. For comparison, in a third series of tests a large dose of uranyl nitrate was injected intramuscularly. The large doses of the soluble compound produced death promptly; smaller doses were followed by 100% mortality in 14 to 26 days. On the other hand, even a large dose of U_3O_8 was not acutely toxic although a small weight loss was observed. All doses of uranyl nitrate produced weight losses of 2 to 2.5 per cent of the body weight per day.

The effects on urine volumes were complicated, but may be grouped in three categories: (a) oliguria following large doses of the soluble compound, (b) normal urine volumes following intermediate doses of the soluble compound, (c) polyuria following small doses of the soluble compound or a large dose of the insoluble compound. Albuminuria was observed much more frequently than was glycosuria. Maximum blood concentrations of uranium (2 to 4 micrograms per cc) were observed in a few hours after large doses of uranium nitrate; smaller doses gave lower blood concentrations. When U_3O_8 was given, no detectable uranium appeared in the blood.

The soluble uranyl nitrate was promptly excreted via the urine; the insoluble U_3O_8 was excreted via the feces. The removal of the uranium compounds from the lungs occurred at rates that were dependent far more on the amount of material administered than on the solubility. Sixty to seventy per cent of a large dose remained in the lungs 8 hours after administration; whereas only 20 to 40 per cent of a small dose remained. The removal continued so that after a week only 5 to 20 per cent of any dose was recovered in the lungs. About 10 per cent of the dose of the soluble compound, regardless of the size of the dose, was deposited in the bone. In the ensuing three weeks there was little mobilization from this site. Nearly

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the same fraction of the dose originally appeared in the kidney; however, this uranium tended to be lost in the ensuing days.

When a large dose of uranyl nitrate was injected into a muscle, the uranium was fixed and was mobilized very slowly. In 6 hours 90 per cent of the dose was still in situ, 5 per cent had been deposited in the bone, and about the same amount in the kidney. After about 6 days, nearly 80 per cent of the original dose was still present in the muscle.

612 Uranyl Nitrate; Four One-Year Inhalation Toxicity Studies of Animals, by Robert G. Yaeger. AECD - 2129 (UR-30), May 17, 1948, decl. July 21, 1948. 112 p. Informal disposition and for publication in NNES.

A comparison of the effects of daily inhalation exposure of animals for one year to uranyl nitrate was made by 4 studies performed concurrently at concentrations of 0.08, 0.3, 0.5 and 4 mg/m^3 of air, respectively. Approximately 24 dogs and 200 rats were exposed at each level; 20 rabbits and 30 guinea pigs were added to the 2 highest levels 5 1/2 months after the start of exposure of dogs and rats.

Neither the dog nor the rat exposed to concentrations below 0.5 mg/m^3 of dust (approximately 0.3 mg/m^3) at the end of a one-year period showed appreciable weight loss, significant biochemical change, or renal damage when compared with controls. Exposure at this level produced some degree of injury in almost all exposed dogs, in 50 per cent of the rabbits, but only in an occasional rat, and no changes whatsoever in the guinea pig. Associated with renal injury was biochemical evidence of blood NPN elevation, urinary protein and plasma carbon dioxide decrease. At the 4 mg level only one dog was free from renal injury of some degree from uranium. In this group of animals injury was marked in 1, moderate in 11 and mild in 3. Likewise all rabbits showed renal injury from extensive to slight and 2/3 of all rats showed varying degrees of renal injury from traces of acute injury to marked atrophy; the guinea pig kidney showed no changes at this level. The guinea pigs and the rabbits, however, were exposed for only 6.5 months. Only at the highest level did appreciable accumulation of uranium occur in the tissues and this was confined chiefly to the hard tissues; minimal amounts of uranium were found in both bone and tooth at the 0.5 mg level. In the 4 studies comprising almost 1000 animals, only 1 dog and 22 rabbits died from causes attributable wholly or in part to uranium.

Thus, exposure at concentrations below 0.5 mg uranyl nitrate/m^3 for one year appears to be essentially noninjurious and constitutes safe exposures for dogs and rats. The level of 0.5 however, was moderately injurious to the majority of dogs and rabbits exposed, mildly so to rats, and completely nontoxic to guinea pigs. Four milligrams of uranium nitrate dust was almost uniformly injurious to dogs, rabbits, and rats, though less so to the rabbit species, and completely nontoxic to guinea pigs.

613 Hematological Studies of Plutonium Project Personnel; Effect of Exercise on Leucopenia; a Statistical Analysis, by E. K. Marks, George Sacher, and L. O. Jacobson. AECD - 2133 (ANL-HDY-466), February 1948, decl. July 22, 1948. 20 p. For publication in NNES.

Leucocyte and differential leucocyte counts were made on thirty-five subjects immediately before, immediately after, and 15 minutes after the subjects performed the "standing running exercise." These individuals were male and female employees of the Metallurgical Laboratory. One group was selected

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BIOLOGY, GENERAL

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from those who worked in that part of the laboratory where exposure to ionizing radiations up to the tolerance amount was possible, and the other had no known exposure to significant amounts of such radiations. Certain individuals in the exposed group had leucopenias; radiation exposure was suspected in the etiology of these leucopenias. The effect of exercise on the leucocyte response of the leucopenic and non-leucopenic individuals in the exposure group was compared to the response of the control unexposed group. Upon analysis no difference in response of these two groups was noted; all responded with an increase in leucocyte values immediately after completion of the exercise. The increase was comparable in the exposed and non-exposed individuals. Furthermore, no change in the stage of maturation of the polymorphonuclear neutrophils or morphological change in the lymphocytes was noted in either group.

The evidence suggests that the response to the exercise test is due to a transient alteration of the distribution of mature cells in the vascular system and lymphatics as a result of increased blood flow. The test could thus be of little value in detecting a decreased response potentiality of the leucoporitic tissues as a result of exposure to radiations.

614 Skin Lesions in Persons Exposed to Beryllium Compounds, by Robert S. Grier, Peter Nash, and David G. Freiman. Journal of Industrial Hygiene and Toxicology 30, p. 228-237, July 1948.

Three cases of subcutaneous granuloma arising in persons who have cut themselves on broken fluorescent lamps coated with beryllium-containing phosphor are described. The pathology of these lesions is similar to that seen in the skin lesions of two beryllium workers who had pulmonary granulomatosis, and essentially similar to the lung lesions seen in this disease. Because of the danger of recurrence, treatment should involve complete excision. If other cases of subcutaneous granuloma arising in this way are to be avoided caution must be exercised in the disposal and salvage of burnt out fluorescent lamps.

BOTANY, GENERAL

615 Influence of Radioactive Materials on Crops. Journal of the American Medical Association 137, p. 976, July 10, 1948.

The Atomic Energy Commission and the Department of Agriculture have announced a study of the influence of radioactive materials on growth of crop plants. The project will aim to determine the effects of radioactive materials used in fertilizer applications, not as tracers measuring the effects of standard fertilizer materials, but as a direct influence on the fertilized crops. Investigations by qualified American and Japanese scientists failed to reveal any basis for the claim that radiation from the atomic bomb benefited crops at Nagasaki. Except for experimental purposes, the use of radioactive material by farmers cannot be recommended on the basis of present knowledge.

CHEMISTRY, ANALYTICAL

616 New Method of Quantitative X-Ray Analysis, by I. B. Borovski. Doklady Akademii Nauk SSSR 59, p. 29-32, 1948.

617 X-Ray, Electron, and Neutron Diffraction, by C. G. Shull and E. O. Wollan. Science 108, p. 69-75, July 23, 1948.

Some comparisons are made of the results which can be obtained by these three techniques, and their advantages and disadvantages in particular applications are outlined. The newly developing field of neutron diffraction appear to have advantages over the older fields of X-ray and electron diffraction in some problems involved in the determination of crystal and molecular structures. The most important application for which this seems to be the case is in connection with the location of hydrogen or deuterium positions. So far, only very simple examples of such determinations have been carried out, but from these studies it would seem that there is no serious obstacle in the way of extending the technique to more complicated cases, especially where deuterated compounds can be used. If this is the case, neutron diffraction may become a very useful tool in the study of the structure of organic compounds. However, really rapid progress along this line cannot be expected, since in any case complicated structure determinations are very time-consuming problems; also, the very limited facilities for work in this field which result from the requirement of a chain-reacting pile as a source will make progress less rapid than in the corresponding fields of X-ray and electron diffraction for which adequate sources can be procured by any laboratory.

CHEMISTRY, GENERAL

618 Chemical Degradation of Isotopic Succinic and Malic Acids, by A. A. Benson and J. A. Bassham. AECD - 2123 (UCRL-118), May 25, 1948, decl. July 19, 1948. 5 p. For publication in Journal of the American Chemical Society.

A chemical degradation of isotopic succinic acid using the Curtius reaction has been adapted for small quantities; it accurately gives the distribution of C^{14} in the methylene groups and carboxyl groups. The methylene groups, isolated as ethylenediamine dihydrochloride, are obtained entirely free from other radioactivity. An oxidation of isotopic malic acid is also reported and is capable of separating the alpha, beta, and the carboxyl carbon atoms. This method is also applicable to the degradation of isotopic aspartic acid.

619 A Study of the Effect of a Number of Column Variables, by E. R. Tompkins, D. H. Harris, and J. X. Khym. AECD - 2128, n.d., decl. July 19, 1948. 30 p. For publication in a suitable technical journal.

The effects of several variables on the efficiency of an ion-exchange column for the applications of volume reduction and separation of several cationic fission products have been studied.

When the flow rate per unit area was held constant at 1.0 ml/cm^2/min, the column area was found to affect the width of the elution curve. The effect of column length on the width of the elution curve differed slightly from that predicted from theoretical considerations. Flow rate was an important factor in both volume reduction and separations column applications. The original form of the resin was

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found to be important. For obtaining the maximum volume reduction factor, the resin should be in the hydrogen form initially, and the elution of rare earths should be made with citrate at a pH of 3.3 - 3.5. These conditions are not optimum for separations. For this purpose it is preferable to elute the mixture of rare earths from a column of resin in the ammonium form using citrate at a lower pH. Addition of carrier had a deleterious effect on the separation of solutes. This was very pronounced when Amberlite IR-1 was used, but was much less pronounced when Dowex 50 was employed.

The results of this investigation, together with data obtained previously, were used as a basis for the design of an ion-exchange column apparatus for separating and purifying fission products. The principles involved in this apparatus are applicable for the separation of other substances. The results of these experiments aid in the interpretation of the theory of ion-exchange column operation.

620 The Use of Uranium and Uranium Compounds in Purifying Gases, by Amos S. Newton. AECD - 2135, n.d., decl. July 20, 1948. 10 p. For publication in NNES.

It has been found that with a simple setup uranium and certain uranium salts are very useful for purifying several commonly used gases to a high degree of purity. This method was first used with argon but has since been extended to include hydrogen, nitrogen, hydrogen chloride, hydrogen bromide, and chlorine.

The method is based on the reactivity of uranium metal (it being quite active and forming no protective skin of oxide), the formation of a hydride of uranium which can be decomposed to yield hydrogen and the metal at a reasonably low temperature, and the fact that the oxide of uranium is more stable than the nitride of any of the halogen salts except perhaps the fluoride.

621 Extraction of the Active Deposit of Slow Evolution from Radium Sulphate, by M. A. Rollier. Rendiconti Istituto Superiore di Sanita 7, p. 284-295, 1944.

A procedure is described by which a sample of $RaSO_4$, in which the long-life disintegration products had accumulated for 5 years, was converted into the chloride by fusion with a Na_2CO_3-K_2CO_3 mixture followed by extraction with HCl. The active deposit of slow evolution was then removed with H_2S using Cu as a carrier. An intense source of neutrons was also prepared by mixing $RaCl_2$ with finely powdered Be.

622 Heat of Formation of Beryllium Carbonate, by A. F. Kapustinski and M. S. Stakhanova. Doklady Akademii Nauk SSSR 57, p. 575-578, 1947.

CHEMISTRY, GENERAL

623 Microsynthesis of C^{14} Labelled Ethyl Iodide, by W. J. Arrol and Raymond Glascock. Nature 161, p. 932, June 12, 1948.

A procedure is described whereby carbon dioxide labelled with C^{14} can be converted in good overall yield to ethyl iodide by the way of acetylene and ethylene on the scale of about 10 micromoles.

CORROSION AND ANTI-CORROSION

624 An Introduction to Metallic Corrosion, by Ulick R. Evans. London, Edward Arnold and Co., 1948. 210 p.

COSMIC RADIATION

625 The Average Life of Mesons of Cosmic Radiation, by W. Opechowski, Archives de Musee Teyler 9, p. 543-550, 1947.

Attention is called to a contradiction which seems to exist between results of direct determinations of the average life of τ mesons at rest and those of determinations of the ratio τ: μ where μ is the mass of the meson. An explanation is proposed for this contradiction by supposing that the penetrating component of cosmic radiation contains in addition to mesons of average life around 1.5×10^{-6} seconds, particles of greater average life (probably 10^{-3} sec.).

626 Cloud-Chamber Study of Electrons from Meson Decay, by Jacob L. Zar, Joseph Hershkowitz, and Evelyn Berezin. Physical Review 74, p. 111-112, July 1, 1948.

An experiment is under way to determine the energy spectrum of electrons arising from decay of mesons at sea level. Three cloud-chamber tracks have been obtained. Range and scattering observations are consistent with energies of 13, 18, and 50 Mev. Results obtained appear difficult to reconcile with a monochromatic energy for μ-meson electron decay. A possible explanation is an energy distribution for decay electrons with a maximum frequency below 14 Mev. The experimental arrangements for this study are described.

627 Cosmic Rays and the Nuclear Structure of Atoms, by H. Wambacher. Oesterreichische Chemiker-Zeitung 43, p. 116-121, 1940. (In German)

A summary is given of the phenomena of cosmic rays. Their significance in the interpretation of nuclear structure is indicated.

COSMIC RADIATION

628 Evidence for Heavy Nuclei in the Primary Cosmic Radiation, by Phyllis Freier, E. J. Lofgren, E. P. Ney, F. Oppenheimer, H. L. Bradt, and B. Peters. Physical Review 74, p. 213-217, July 15, 1948.

Recent high altitude flights in free balloons have given evidence for the existence of nuclei of atomic number up to about 40 and kinetic energies of about 0.5 Bev per nucleon as a component of cosmic radiation above 90,000 feet. Tracks of such particles were observed both in a cloud chamber and in Ilford nuclear emulsions. The tracks obtained are discussed and some of the photographs are reproduced. The procedure followed in making the experiment is given.

629 An Example of the Beta-Decay of the Light Meson, by E. C. Fowler, R. L. Cool, and J. C. Street. Physical Review 74, p. 101-102, July 1, 1948.

Photographs are presented showing two views of a large Wilson cloud chamber in which the beta decay of a light meson was detected. The event that was observed could not have been the decay of a heavy meson to a light meson (the π-μ decay). The observed angles of deflection for a typical track corresponded to an energy of 110 Mev for an electron.

630 Study with Counters of the Transitional Effect of Cosmic Rays in the Stratosphere, by S. I. Brikker, S. N. Vernov, I. M. Evreinova, S. P. Sokolov, and T. N. Chakhurian. Doklady Akademii Nauk SSSR 57, p. 141, 1947.

631 Study with an Ionization Chamber of the Transitional Effect of Cosmic Rays in the Stratosphere, by S. N. Vernov, N. L. Grigorov, and F. D. Savin. Doklady Akademii Nauk SSSR 57, p. 137, 1947.

CRYSTALLOGRAPHY

632 The Crystal Structures of ThH_2 and ZrH_2, by R. E. Rundle, A. S. Wilson, R. Nottorf, and R. F. Raeuchle. AECD - 2120, n.d., decl. July 19, 1948. 9 p. For publication in Acta Crystallographica.

The X-ray structures of ThH_2 and ZrH_2 are reported. Possible hydrogen positions in the hydrides are discussed. ThH_2 is at least pseudotetragonal with a = 4.09, c = 5.02, kx = 2, and is pseudoisomorphous with ZrH_2. Both ThH_2 and ThC_2 seem to require more complex units, but the extra weak lines in their powder patterns suggest that they are not truly isomorphous.

The possible hydrogen positions in the hydrides are examined, and it is concluded that a structure containing M-H-M bridges is the most probable. The bond distances for this structure are in fair agreement with predictions from Pauling's rule, with the exception of rather long Th-Th distances in ThH_2.

CRYSTALLOGRAPHY

633 The Structure of $TiCl_2$, by N. C. Baenziger and R. E. Rundle. AECD - 2130, n.d., decl. July 22, 1948. 3 p. For publication in Acta Crystallographica.

$TiCl_2$, prepared by reducing $TiCl_4$ with H_2, has the CdI_2 structure. Lattice parameters and intensity calculations are given.

634 The Accuracy of Atomic Coordinates Derived from Fourier Series in X-Ray Crystallography, Part 5, by A. D. Booth and K. H. V. Britten. Proceedings of the Royal Society 193 A, p. 305-310, July 2, 1948.

In the first paper of this series the effect of experimental errors in the Fourier coefficients upon the derived atomic coordinates was investigated. The assumption was made that the probable errors were independent of the magnitudes of their parent Bragg reflections. It has been suggested that a more accurate assumption would be to take the probable error of any coefficient as being proportional to the magnitude of that coefficient. The present paper develops the theory on this basis, and a solution in closed form is obtained.

The question of how the experimental error in the coordinates varies with the position of the atom in relation to its neighbours is also investigated, and it is shown that the variation is much smaller than that previously derived for finite summation errors.

635 Calculation of Atom Radii in Crystals, by E. S. Sarkisov. Doklady Akademii Nauk SSSR 58, p. 1337, 1947.

636 Effect of the Piezoelectric Properties of a Crystal on Diffuse X-Ray Reflections, by David C. Miller. Physical Review 74, p. 166-169, July 15, 1948.

A study of the diffuse X-ray reflections from piezoelectrically oscillating quartz and ammonium dihydrogen phosphate (ADP) crystals showed no increase in intensity during oscillation. Quantitative measurements of the intensity increase of the Laue and Bragg reflections during oscillation showed an increase of about 160 per cent for the quartz, 7.7 percent for a 0.015 inch thick ADP crystal and 4 percent for a rochelle salt crystal. The intensity increase of Laue reflections for the ADP crystal was shown to be dependent upon its orientation. Since there was no decrease in intensity of the diffuse reflections, it eliminates the possibility that they are the source of the increased energy in the Laue and Bragg reflections.

HEALTH PROTECTION

637 The Tolerance Dose and Prevention of Injuries Caused by Ionizing Radiations by Rolf M. Sievert. British Journal of Radiology 20, p. 306-318, August 1947.

The range within which a skin reaction changes from a mild erythema to an irreversible reaction is relatively small. Fractionation is accompanied by reduced skin reaction. It has been found that 1000 r in a single dose produced an erythema and 3000 r skin necrosis. With fractionation over thirty days, erythema appeared after 2600 r and necrosis after 8000. Because of normal variations blood changes are difficult to evaluate. The most pronounced changes seen are hypersegmentation, pathological lymphocytes, granulocytopenia, and a shift to the left. Thrombocytes diminish after irradiations. Sterilization is generally considered to follow 300 to 400 r in a single dose. Blood changes generally appear before sterility need be feared.

Studies indicate that the skin tolerance dose is between 0.1 and 0.5 r per day. The safety tolerance dose for blood changes is about 0.01 r per day. For radiations originating within the body the equivalent of 10^{-11} to 10^{-10} curies per liter should not be exceeded. Sufficient data to establish a tolerance dose for genetic effects or for effects upon sterility is not available.

A summary of the Swedish law regarding control of radiological work is given. Considerable risk has been discovered in small installations not controlled by trained radiologists. Dental radiography, always regarded as relatively safe, was found to offer considerable risk. Studies of mass-miniature radiography technic have shown great opportunity for injury to the blood.

INSTRUMENTS

638 Progress Report; Development and Construction of Alpha-Counting Equipment, by R. H. Firminhac. AECD - 2112 (CP-1645; A-2492), July 4, 1944, decl. July 8, 1948. 5 p. Disposition as required for use in research, development, or manufacturing work. This includes declassification of the ionization chamber adapted for alpha counting.

An ionization chamber for use in counting the alpha-particle activity of air contaminants has been devised for the activity of material collected with the electrostatic precipitator. The chamber is an adaptation of the breech-locking standard chamber, with a cylindrical high voltage electrode into which the collection foil is placed, and a coaxial rod as a collecting electrode. A geometrical efficiency of close to 50% is obtained. The standard California amplifier and scaling circuit can be used with the chamber. Design drawings are given.

639 A Geiger-Müller Counter for Measuring the Beta-Ray Activity of Liquids, and Its Application to Medical Tracer Experiments, by N. Veall. British Journal of Radiology 21, p. 347-351, July 1948.

A Geiger-Müller counter of the jacketed tube type for β-ray measurements on liquid samples is described, together with a convenient means of mounting in a lead shield. It is shown that the counting rate obtained when the counter is filled is proportional to the concentration of radioactive substance in the solution. Methods for applying corrections for errors due to dead time of the counter and for variations in specific gravity of the solution are given, together with a calibration curve showing the absolute efficiency of the counter for various radioactive isotopes. The counter has proved useful for measurements of the radioactivity of whole blood, plasma, urine, etc., in medical tracer experiments.

INSTRUMENTS

640 A Spherical Geiger-Müller Counter, by G. Salvini. Ricerca Scientifica e Ricostruzione 17, p. 914-916, 1947.

The author has constructed a counter consisting of a spherical glass bulb silvered on the inside and having an anode of steal or tungsten wire in the form of a ring. It has all the characteristics of an ordinary cylindrical counter but possesses a higher degree of symmetry.

641 X-Ray Spectrometer with Geiger Counter for Measuring Powder Diffraction Patterns, by J. Bleeksma, G. Kloos, and H. J. Di Giovanni. Philips Technical Review 10, p. 1-12, July 1948.

With a spectrometer described in this paper X-ray diffraction patterns are traversed by a Geiger counter tube detector instead of being recorded in the conventional fashion on photographic film. The Geiger counter tube, also developed in a form especially adapted to the measurement of X-ray intensities, is applied in a well known focusing arrangement, making use of a large flat specimen (dimensions of active area, e.g., 1 x 2 cm). Due to the extremely high sensitivity of the courter tube, to a high apparent X-ray "brightness" of the focal spot which is used at a glancing angle of only 1.5°, and to the large specimen surface contributing to the diffraction intensity, and X-ray tube rating as low as 125 W is sufficient. The measurement of the intensity of the diffraction lines is effected, (a) by counting the current pulses produced in the Geiger tube by the entering X-ray quanta, a scaling circuit making this possible at radiation intensities of several thousand quanta per second at the tube window, or (b) by measuring, after amplification, the mean value of the current through the Geiger tube by means of a milliammeter; the milliammeter reading can be automatically recorded while the spectrum is being scanned, thus producing a chart which immediately indicates the relative line intensity as a function of the diffraction angle. The scanning speed, as well as the averaging time for the mean current measurement, can be chosen between wide limits. The accuracy of the determination of diffraction angles and relative intensities, and the resolving power for adjacent diffraction lines are better than with the commonly used photographic methods, under comparable electric and geometric conditions. Moreover the Geiger counter spectrometer offers additional distinct advantages for applications in which the accurate measurement of only a few lines is desired.

642 Velocity and Two-Directional Focusing of Charged Particles in Crossed Electric and Magnetic Fields, by N. Svartholm. Physical Review 74, p. 108-109, July 1, 1948.

The two directional focusing in an inhomogeneous magnetic field proposed by K. Siegbahn and the author has been applied in the construction of a new β-spectrometer. The principles of the system are discussed. As an immediate consequence of these principles it should be possible to increase the resolving power of a Bleakney or Nier spectrometer by introducing two deflectors of approximately parabolic profile.

ISOTOPES

643 Segre Isotope Chart (Revised), by E. Segre. AECD - 2111 (BP-53), April 1948. decl. July 21, 1948. 1 p. Informal disposition and for publication in the revised edition of Science and Engineering of Nuclear Power, ed. by G. D. Goodman.

This chart is a revision of MDDC - 626, which was in turn a revision of MDDC - 184.

644 The Varieties, Quantities, and Purities of Stable Isotopes Which Have Been Concentrated Electromagnetically, by C. P. Keim. AECD - 2116 (Y-147), March 22, 1948, decl. July 19, 1948. 2 p. For publication in Science.

The varieties of stable isotopes separated by the electromagnetic process along with the probable quantities available for shipment and expected purity are listed. These figures are based on approximately two hundred isotope collections.

METALLURGY

345 Annual Progress Report; Metals Research Laboratory and Department of Metallurgical Engineering. Pittsburgh, Carnegie Institute of Technology, 1947. 38 p.

The work being done is outlined and the results obtained on the following problems are given: freezing of metals; constitution of alloys; microscopy by radioactivity; diffusion; age-hardening; heat treatment; oxidation of solid metals; mechanical metallurgy; recrystallization; powder metallurgy; physics of metals; and process metallurgy.

646 Developments in Metals and Alloys for Chemical Plant Equipment, by W. Z. Friend. Chemical Engineering Progress 44, p. 501-510, July 1948.

Metals and alloys used for high temperatures chemical plant equipment are discussed. The properties of the following alloys are reviewed: aluminum alloys, copper and high-nickel alloys, iron-nickel alloys, stainless steels, high-cobalt alloys, Hastelloy alloys, and Inconel alloys.

647 Highly Refractory Oxides, by V. M. Tsynkina. Kislorod 3, Nos. 2-3, p. 56-60, 1946. (Available in English as Translation No. 2102, Henry Brutcher, Altadena, Calif.)

Extensive data on zirconium oxide and brief information on beryllium and thorium oxides are given. Applications of these oxides as refractories are discussed.

METALLURGY

648 An Introduction to the Physics of Metals and Alloys, by W. Boas. New York, Wiley, 1947. 195 p.

The properties of metals and alloys are explained in terms of the properties of atoms. The methods by which alloys with desired properties can be produced are indicated. The principles of X-ray analysis, properties and deformation of metals, and phase changes in alloys are included.

649 Zirconium High Temperature Refractory Formed from Mariopole Zirconium Concentrate, by I. I. Kitaigorodski and N. V. Solomin. Doklady Akademii Nauk SSSR 56, p. 839-841, 1947.

Periodicals listed in this abstract journal are on file in the Library of Congress. The Union List of Serials may be consulted for the availability of these publications in other libraries. Members of the American Chemical Society may purchase microfilms or photoprints of some of the articles listed through this Society.

NEUTRONS

650 Neutron Diffusion at Large Distances from the Source, by H. A. Bethe. AECD-2105 (KAPL-56), April 6, 1948, decl. July 9, 1948. For publication in Nucleonics.

For many problems it is important to know the neutron density at large distances from the source where its value has decreased to 10^{-5} or 10^{-10} of the density near the source. The customary age theory breaks down in this case, and various improvements on this theory such as the spherical harmonics method are also insufficient. On the other hand, the asymptotic theory of Wick becomes valid only at distances of $z \gg u'$ where $u' = u/\epsilon$ is the number of collisions. For the moderate value $u' = 20$, this means $z \gg 8000$, and the attenuation is about e^{-z}! It is the purpose of this paper to bridge the gap between "age theory" and "asymptotic theory".

The notations of Marshak (Reviews of Modern Physics 19, p. 185, 1947) are used except where otherwise noted. All distances are measured in units of the mean free path which is assumed independent of the velocity of the neutron. The showing-down medium is assumed to be non-absorbing, and to be an element of atomic weight M large when compared with 1 ($M \gg 9$). The theory proposed is a development of the "one-velocity theory" described by Marshak. It gives results accurate to 10 or 20 per cent for any distance provided only the number of collisions, u', is large; a condition which is satisfied in many problems of practical interest. This is in contrast to the spherical harmonics method, which breaks down at distances, z, of the order $u'^{3/4}$ or at attenuations of the order $e^{-u'^{3/4}}$. Placzek's extension of the spherical harmonics method extends this to attenuations of the order $e^{-u'^{2/3}}$; it represents a second approximation to the theory developed in this paper.

651 Comparison of the Variation-Theory and End-Point Results for Tamped Spheres, by S. Frankel and K. Fuchs. AECD-2131 (LADC-77), n.d., decl. July 21, 1948. 4p. Informal disposition. Document for sale by AEC.

The end-point and variation results presented in previous reports are shown to agree throughout that part of the range of applicability of the end-point method (core and tamper thicknesses greater than 0.3 attenuation distances) in which the variation results have been calculated (up to 1.0 attenuation distance). For smaller dimensions the variation results are valid, and for larger sizes the end-point method applies. Large discrepancies are found only for the extrapolated portions of the variation results.

652 Thermal Neutron Cross Sections for Elements and Isotopes, by Katherine Way and G. Haines. AECD-2138 (CNL-33), February 29, 1948 decl. July 23, 1948. 20p. Informal disposition. Document for sale by AEC. (See also MDDC-1392.)

In Table I (Thermal Neutron Cross Sections for Elements) the compilers give their judgement of the best values of the absorption (A) and scattering (S) cross sections of the elements based on all the experimental data available at present. Where only total cross section measurements have been made, these are given for absorption plus scattering and are marked A + S. The superscript "a" indicates that measurements by different experimenters of the quantity concerned agree sufficiently well so that the quintity may be considered known with at least a 10 per cent accuracy.

In Table II (Thermal Neutron Cross Sections for Isotopes) the values given are the best experimental results for the absorption (A) and scattering (S) and total (T) cross sections based on measurements of each particular cross section. For this reason the table may show discrepancies between the sums of

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NEUTRONS

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the values for A and S and the corresponding total cross section T. The table also includes masses, spins, abundances, and half lives.

Total cross sections and absorption cross sections are given for a particular neutron velocity, v_o= 2200 m/second, corresponding to a neutron energy of 0.025 ev. Corrections were made to absorption values where necessary by assuming them proportional to 1/v. Scattering cross sections (S) are given for thermal neutrons. If crystal structure affects the scattering at thermal energies, the scattering cross section (S') for neutrons whose energy is $\sim$ 1 ev is given.

653 A Convergent Expression for the Magnetic Moment of the Neutron, by D. Rivier and E. C. G. Steucklberg. Physical Review 74, p. 218, July 15, 1948.

Calculations of the magnetic moment of the neutron have always yielded divergent results. The authors have avoided this diffuculty by the use of an invariant perturbation method based upon the S matrix theory. The magnetic moment remains finite but no definite numerical value comes out of the calculations. The method is quite general and can be applied to all diverging expressions arising from field quantization.

654 On the Neutron-Proton Force, by John M. Blatt. Physical Review 74, p. 92-96, July 1, 1948.

It has been pointed out previously that neutron-proton scattering experiments at energies below approximately 10 Mev do not give any detailed information about the neutron-proton force. They determine only the strength and range of the force, not its exact distance dependence. The author analyzes scattering experiments in order to find the equivalent ranges in the triplet and singlet states. He concludes that if the nuclear potential is not "long-tailed", the effective triplet range is between 1.30 and 1.55 $\times$ 10^{-13} cm, and the effective singlet range is less than 2.0 x 10^{-13} cm (in contradiction to the hypothesis of the charge-independence of nuclear forces).

655 Evidence for Neutrons Associated with the Stopping of Sea Level Mesons in Lead, by R. D. Sard, W. B. Ittner III, A. M. Conforto, and M. F. Crouch. Physical Review 74, p. 97-98, July 1, 1948.

An experiment is being carried out which was designed to detect the neutrons emitted by nuclei that have captured light mesons. A time correlation has been found between the stopping of a penetrating charged particle, indicated by a Geiger-Mueller tube anticoincidence, and the detection of a neutron. The ratio of particles stopped in the lead to neutron coincidences was found to be 51.6: 0.34, or 152. Allowing for a 20% positive excess it is concluded that there is one neutron coincidence per 61 negative mesons stopped. It is not entirely impossible that the neutron coincidences are due to stopped protons, which may amount to as much as 5% of the number of stopped mesons.

NEUTRONS

656 Inelastic Scattering of Neutrons by J. M. Cassels and R. Latham. Physical Review 74, p. 103-104, July 1, 1948.

Using Weinstock's theoretical paper (Physical Review 65, p.1, 1944) on the scattering of neutrons by polycrystalline materials, the inelastic scattering cross section (E_{in}) of iron at five temperatures for incident neutron wave lengths ranging from 1.79 to 20 A has been calculated. Since iron has four stable isotopes, one of which possesses spin, the theory was examined to see which scattering cross section was relevant. The theory was tested by measuring with the aid of a velocity selector the total cross section of iron in the 5-8 A region. The experiment indicated that the inelastic neutron scattering is more than the theory predicts and perhaps has a different energy dependence in this region.

657 The Polarization of Neutrons by Magnetized Iron, by J. M. Cassels. Physical Review 74, p. 111, July 1, 1948.

Recent measurements of the amorphous and disorder scattering cross sections of iron for slow neutrons permit a redetermination of the mean scattering length of the iron nuclei. The new value is: $(a_r)_{AV} = (1/2\pi^{1/2})\ (11.0-0.8)^{1/2} \times 10^{-12} = 9.01 \times 10^{-13}$ cm.

The significance of this result in the present context lies in the fact that p, the magnetic scattering cross section which determines the magnitude of neutron polarization effects, is proportional to $(a_r)_{AV}$. Halpern, Hamerish and Johnson used a value $(a_r)_{AV} = 7.33 \times 10^{-13}$. Therefore their theoretical values of p should be raised by a factor 1.23.

658 Slowing of Rapid Neutrons in Graphite, by A. Houriet and A. Kind. Helvetica Physica Acta 21, p. 143-150, June 15, 1948. (In French)

A mathematical derivation for determining the retardation of neutrons by graphite is made. Since the energies considered are close to the energy of emission, the width of the emission lines had to be considered.

NUCLEAR PHYSICS - METHODS OF MEASURING

659 Stars in Photographic Emulsions Initiated by Alpha Particles, by Eugene Gardner. AECD -2126 (UCRL-128), June 16, 1948, decl. July 19, 1948. 12 p. For publication in Physical Review.

A study has been made of stars in photographic emulsions initiated by alpha particles from the 184-inch Berkeley cyclotron. These stars are similar to stars initiated by deuterons, which were described in an earlier paper. Eastman NTA plates were used. Plates from the emulsion number used will record alpha particles of energy about 200 Mev and lower and protons of about 10 Mev and lower. The average number of prongs observed is close to 3. The ratio of the number of prongs in the three sectors in the forward direction of the beam to the number in the three backward sectors is about 6. The cross section for the formation of stars has been estimated by counting sections of alpha-particle tracks and the stars associated with these tracks. For alpha particles of energy 130 Mev a value of the cross section was

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obtained, averaged over all of the atoms in the emulsion, of 3×10^{-25} with an estimated uncertainty of 30 per cent.

660 Alkali Halide Scintillation Counters, by Robert Hofstadter. Physical Review 74, p.100-101, July 1, 1948.

A successful attempt was made to detect gamma radiation using KI crystals containing a small Tl impurity and a 931A photo-multiplier tube. NaI powder with added Tl appears to be an even more efficient phosphor than ZnS(Silver) for the detection of α-particles; NaI was also used successfully in the detection of radium gamma rays. A neutron counter using a lithium halide as the phosphor seems to be a reasonable possibility. A more complete report is being prepared.

661 Conductivity Pulses in Liquid Argon, by Norman Davidson and A. E. Larsh, Jr., Physical Review 74, p. 220, July 15, 1948.

Conductivity pulses due to polonium alpha-particles in liquid argon have been observed. No such effect was obtained in liquid nitrogen or in n-heptane at room temperature. There were no pulses in the absence of the radioactivity. When the liquids argon was cooled and solidified, presumably in a polycrystalline condition, conductivity pulses were still observed. An advantage of a liquid counter over a crystal counter would be the absence of space charge accumulation.

662 Electron Tracks in Photographic Emulsions, by R. H. Herz. Nature 161, p. 928-929 June 12, 1948.

Attempts have been made to relate energy and range of electron tracks in a new photographic emulsion referred to as the NT2a plate. The electron tracks were obtained by exposing the plates to heavily filtered X-rays generated at increasing kilovoltages. It is concluded that the maxium energy of electrons which can be recorded with the NT2a emulsion is at about 80 kev. NT2a emulsions were soaked in dilute thorium and uranium nitrate solutions, and electron tracks were recorded at the origin of alpha tracks. Micrographs of the results are shown and briefly discussed. It was observed that some tracks show clumping of grains at the beginning and at the end of tracks. This phenomenon can probably be attributed to the Auger effect.

663 Fading of the Latent Image in Nuclear Emulsions, by W. A. Lamb and F. W. Brown III. Physical Review 74, p. 104, July 1, 1948.

An experiment was made using Eastman NTA plates irradiated with Po^{210} alpha particles which confirms Yagoda and Kaplan's report (Physical Review 71, p. 910, 1947) that the latent image produced by alpha particles in an emulsion with a high percentage of silver halide fades with time. Experiments

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NUCLEAR PHYSICS - METHODS OF MEASURING

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are underway to see if there is a significant difference between the rate of fading of the tracks of highly ionizing particles and that of images produced by visible light.

664 Preparation and Properties of a Photographic Emulsion for the Detection of Charged Particles, by W. Halg and L. Jenny. Helvetica Physica Acta 21, p. 131-136, June 15, 1948. (In German)

Directions are given for the preparation of a photographic emulsion for the detection of heavy charged particles. By use of α-particles of known energy an energy-range relation for α- particles can be obtained from which the corresponding relation for protons can be calculated.

665 Rapid Estimation of the Energies of Electrons of Average and Slow Speeds, Tsein San-Tsiang, C. Marty, and B. Dreyfus. Journal de Physique et le Radium 8, p. 269-275, September 1947. (In French)

The range of an electron is defined as being the distance joining the origin to the extremity of an electronic trajectory. It was established experimentally that the average range of electrons of energy less than 50 kev is according to a constant ratio with the mean course. This relation permits rapid estimation of the energy of mono-kinetic electrons. In the appendices are given the relation between the average range of electrons and their energy (between 1 and 100 Kev), and the ratio between the true average range and its horizontal projection.

NUCLEAR PROPERTIES

666 Polarization of Nuclear Spins, by M. E. Rose. AECD-2119 (ORNL-48), June 9, 1948, decl. July 19, 1948. 16p. For publication in a technical journal and for use in lectures and seminars.

The purpose of the report is to discusss some of the elementary aspects of the theory underlying the problem of polarization of nuclear spins. In addition, a detailed description of the role of hyperfine structure (hfs) coupling is given. In certain special cases, atoms with incompletely filled inner shells the hfs coupling between nuclear and electronic spins may be used to produce appreciable alignment of nuclear spins at low temperatures without the necessity of applying very strong magnetic fields. In the case of solids which have the aforementioned property this will always exist, and except for low temperatures ($\sim 10^{-30}$K) or very strong magnetic fields ($\sim 10^{5}$ gauss) it will be the main mechanism for producing what may be called nuclear paramagnetism or diamagnetism.

NUCLEAR PROPERTIES

667 Binding Energy of the Atomic Nuclei He^4 and He^5, by J. Humblet. Physica 14, p. 285-293, June 1948. (In French).

In the frame of the mixed (vector and pseudoscalar) meson theory, the variational method is applied to the calculation of the binding energies of He^4 and He^5. For the first nucleus the binding energy obrained is 23 Mev. For He^5 the result is practically equivalent to those of Tyrrell and Way who used a Gaussian potential; it is confirmed that this nucleus is unstable against the emission of a neutron.

668 The Radial Dependence of the Tensor Force in the Deuteron, by William G. Guindon. Physical Review 74, p. 145-149, July 15, 1948.

The properties of the deuteron are discussed by means of a neutron-proton potential consisting of but two terms: ordinary force and tensor force, with different radial dependences. Assuming the latter to be square wells of different ranges, the wave functions corresponding to selected pairs of radii for the ordinary and tensor wells are computed, and from these the quadrupole moment is calculated. The results indicate that (a) no special pair of ranges appears preferred in the light of scattering experiments and of the comparison between observed and calculated magnetic moments, (b) the binding energies of heavy nuclei apparently limit the ordinary force range to about $(2.6 \pm 0.1) \times 10^{-13}$ cm, and (c) all empirical data may be fitted, within experimental error, by a very simple potential with equal ranges: $-[1 + S_{12}]J(r)$ with $J(r)$ a square well of depth 13.25 Mev, and of radius 2.663×10^{-13} cm.

Atomic Energy Commission declassified documents listed as available for sale may be obtained from:

Document Sales Agency
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Oak Ridge, Tennessee

NUCLEAR THEORY

669 Mass Spectra of Mesons, by S. V. Izmailov. Doklady Akademii Nauk SSSR 58, p. 1019, 1947.

NUCLEAR TRANSFORMATION

670 Radioactivities Produced in the Platinum Group by Bombardment of Uranium with 400 Million Electron Volt Helium Ions, by Richard D. Wolfe. AECD - 2137 (UCRL - 123), n.d., decl. July 20, 1948. 31 p. For use as a thesis and for publication in a technical journal.

The purpose of the investigation was to determine the yield of radioactivities of the platinum group metals (ruthenium, rhodium, palladium, osmium, iridium, and platinum) produced when natural uranium is bombarded with 400 Mev helium ions. The reason for interest in the yields of these metals is that the last three lie in a region where the plot of yield versus mass number may change from a fission-yield curve to a spallation-yield curve. In addition, the first three lie in a region which should indicate whether the center of the curve has a dip, as does the slow-neutron fission-yield curve, or a single maximum indicating symmetrical fission, as in the case of bismuth and thorium.

A scheme of chemistry is presented for the radiochemical isolation of the platinum metals from the other fission products and from each other. The radioisotopes produced are discussed, their decay and energy values presented in the text and in the form of plots, and finally the yield data are presented in tabular and graphical form. The yield data indicate that the fission-yield curve does have a single maximum in the vicinity of mass 120, and that it apparently becomes continuous with a spallation-yield curve at a minimum of about 0.1 per cent the yield of Ba^{140}, around mass 180.

671 Fission Excitation Functions, by J. Jungerman and S. C. Wright. Physical Review 74, p. 150-152, July 15, 1948. (See also MDDC - 1679)

Excitation functions of the reactions U(α, fission), Th(α,fission), U(d, fission), Th(d, fission) were measured by use of alpha particles and deuterons of maximum energies of 37.6 and 18.8 Mev, respectively. This was done using a stacked-foil technique. Recoil fission fragments were collected on aluminum "catchers" and their beta activities formed a relative measure of the number of fissions occurring during a bombardment. An absolute calibration is described. If no competing processes are assumed, comparison with theory results in effective nuclear radii of 11.0×10^{-13} cm for the interaction of alpha particles with uranium and 9.9×10^{-13} cm for the interaction of deuterons with uranium.

NUCLEONICS

672 Nuclear Physics and the Ceramic Industry, by James R. Johnson. American Ceramic Society Bulletin 27, p. 263-267, July 15, 1948.

A brief summary of the latest ideas on the particles and forces of basic matter is presented. Some applications of radioisotopes as tracers and indicators in ceramic research and production are proposed. A partial list of radioisotopes which might be useful for such research and which are available from the United States Atomic Energy Commission is included.

PARTICLE ACCELERATORS

673 High Voltage Pulser for 184-Inch Cyclotron Electric Deflector, by Q. A. Kerns, W. R. Baker, R. F. Edwards, and G. M. Farly. AECD - 2117 (UCRL-95), April 24, 1948, decl. July 19, 1948. 17 p. For publication in a technical journal. This includes declassification of the high voltage pulser.

This paper describes a high voltage pulse generator developed to deflect the beam of the 184-inch cyclotron at Berkeley, California. The apparatus develops a deflecting potential of 200 kilovolts that rises from 10 per cent to 90 per cent of peak value in 0.1 microseconds. The unit employs two similar 100 kilovolt water-cooled pulse transformers connected symmetrically about ground to the electric deflector bars. Water-cooled General Electric pulse capacitors are discharged through the two turn primary windings of the pulse transformers by triggering a battery of 16 paralleled Kuthe 5C22 hydrogen thyratrons. Output voltages are developed across the 17 turn secondary winding of the pulse transformer. The transformer is mounted in an oil-filled lucite case that provides both insulation and compact design.

674 The Bonn Cyclotron, by W. Schmitz and W. Wiebe. Zeitschrift für Technische Physik 24, No. 9, p. 195-206, 1943.

The cyclotron at the University of Bonn has a 50 cm pole diameter. An illustrated description of the cyclotron is presented and experiences in its construction and operation are ennumerated.

675 X-Radiation from a 20-Mev Betatron, by W. Bosley, J. D. Craggs, W. F. Nash, and R. M. Payne. Nature 161, p. 1022-1023, June 26, 1948.

The authors have investigated the spectrum of the radiation from the 20-Mev betatron (Kerst type) using two methods: the study of electron-positron pairs produced in a thin lead sheet in a Wilson cloud chamber, and the protons liberated in the photo-disintegration of deuterons using either a scattering chamber with a heavy wax target or deuterium loaded plates (Ilford C2 Emulsion). Preliminary results of the experiments are given and the range of energy of the X-radiation emitted is plotted.

PARTICLE ACCELERATORS

676 Wide Range Frequency Modulation, by K. R. MacKenzie. Physical Review 74, p. 104-105, July 1 1948. (See also AECD ≙ 1817)

The cyclotron frequency modulation systems so far proposed utilize mechanical variation of capacity. The capacity is most effective when placed at the leading edge of the dee. In this position many difficulties are introduced. A system has been developed in which the variable capacitor is outside the magnetic field. Tests made with a one-half scale model of the proposed system for the 184-inch cyclotron show that a frequency range of 2.4 to 1 can be covered continuously. This range can be shifted approximately 10 per cent by addition of fixed inductance or capacity. Since the frequency ranges required for protons and deuterons in the 184-inch magnetic field are 22.9 to 15.8 megacycles, and 11.5 to 9.8 megacycles, respectively, it seems that the cyclotron can accelerate either type of ion by making minor adjustments, or possibly both ions at once if so desired. Recent measurements on the 184-inch cyclotron indicate that the required frequency range need be only a few per cent greater than the theoretical range, and also the shape of the frequency time curve is not critical. A schematic diagram is shown and discussed.

PETROLEUM INDUSTRY

677 Existence of Uranium in Petroleum, by E. Longobardi. Boletin del Instituto Sudamericano del Petroleo 2, p. 608-609, October 1947.

The existence of uranium in asphalts and other carbonaceous materials including oil shale are briefly noted. A test on crude oil from El Sosneado showed marked signs of radioactivity.

678 The Use of Neutrons for Investigating Oil Wells with Gamma Rays, by G. V. Gorskov and N. M. Lyatkovskaya. Doklady Akademii Nauk SSSR 55, p. 607, 1947.

679 Well Logging Methods, Petroleum Bibliography No. 26. Tulsa, Okla., Tulsa Public Library, 1948. 13 p.

This bibliography is divided into the following sections: caliper, electrical, geochemical, geothermal, mud well, and radioactivity well-logging.

PHYSICS, GENERAL

680 Heat of Sublimation and Vapor Pressure of Graphite, by O. C. Simpson, R. J. Thorn, and G. H. Winslow. AECD - 2110 (ANL-4158), May 28, 1948, decl. June 28, 1948. 19 p. For oral presentation before an American Chemical Society Symposium on High Temperatures held June 28, 1948, and for publication in Journal of Chemical Physics.

Since the graphite evaporated to the monoatomic form in the two experiments described in this report, the experimental heats of sublimation, ΔH_3, should be the same as the heat of sublimation to the

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monoatomic form. From the slope of the $\log_{10}(a\sqrt{T})$ versus $\frac{1}{T}$ curve and heat capacity data to correct ΔH_1 to absolute zero the writers conclude that $\Delta H_1 = 178 \pm 9$ kcal per mole (at 0°K). A reasonably complete and detailed analysis of the data from the two experiments permitting an accurate calculation of the degree of saturation of the vapor above a flat surface is difficult to carry out. Work on this determination is in progress. On the basis of the assumption that the holes in the perforated surface were saturated to the extent of $\frac{S}{S+s}$, in which S is the surface area of the hole and s is the area of the hole exit, the vapor pressure measurements given indicate that the vapor above the flat surface was 80 per cent saturated at 2500°K. This figure is only an estimate, but on the basis of the data collected it indicates that the degree of saturation above a flat surface cannot be greatly different from unity. Hence the values given of ΔE°_0, the heat of sublimation at absolute zero, cannot be in error to a large extent due to this factor, since it changes ΔE°_0 by $4.575\ T \times 10^{-3} \log_{10} f$ kcal per mole or for f = 0.8 by −0.6 kcal per mole. This, together with the other errors estimated by the writers, gives $\Delta E^\circ_0 = 174 \pm 3$ kcal per mole.

For the vapor pressure the data obtained gives $\log_{10} p(mm) = -\frac{3.821 \times 10^4}{T} + 11.019$. In view of the values obtained in this investigation and elsewhere (i.e., 177 kcal per mole), the writers agree that the total evidence indicates that the spectroscopic value of $\Delta H_1 = 170.6 \pm 0.2$ kcal per mole (at 0°K) is the correct one for graphite evaporating into the ^3P state.

681 Electron Momenta in Atoms, by W. E. Duncanson and C. A. Coulson. Proceedings of the Physical Society 60, p. 175-183, 1947.

Theoretical expressions are obtained for the momentum distribution of the electrons in atoms of different atomic numbers. For a given momentum density curves can thus be drawn. The mean momentum increases steadily with atomic number. These results are used to extend the earlier work on the shape of the Compton profile from Na to monatomic K.

682 Measurement of Alpha-Active Dust in the Atmosphere, by Hugh Carmichael and P. R. Tunnicliffe. Journal of Industrial Hygiene and Toxicology 30, p. 211-227, July 1948.

Apparatus of two kinds for rapidly extracting the dust from large volumes of atmospheric air so that the alpha particle activity of the dust can readily be measured in a methane proportional counter is described. The performance of the apparatus has been studied using the natural alpha activity in the atmosphere due mainly to radon and thoron and their disintegration products. Suction provided by a commercial vacuum cleaner, is at the rate of 2.0 ca.m./min. in the electrostatic precipitation apparatus, but only 0.8 cu.m./min. in the filter apparatus. Extraction of dust at these rates of flow is 40 per cent for the filter. Counting efficiency is 49 per cent for the precipitator but only 14 per cent for the filter due to penetration of the dust into the paper. The overall counting yield of the precipitator for a given time of extraction of dust is nearly four times that of the filter. It is necessary to have both types of apparatus in order that experimental determinations of the counting yield to either can be made from time to time. At least six hours must usually elapse after collection of a dust sample before uranium or plutonium of about the present health toleration concentration can be measured because the natural alpha particle activity of atmospheric dust must first be allowed time to decay.

QUANTUM MECHANICS

683 Characteristic Values of Spheroidal Wave Functions, by W. F. Eberlein. Physical Review 74, p. 190-191, July 15, 1948.

An asymptotic expansion for the characteristic values of the (prolate) spheroidal wave equation is obtained. The expansion contains the Ince-Goldstein expression for the characteristic values of the Mathieu equation as a special case ($m = -1/2$).

684 The Mass-Energy Relation, by W. F. G. Swann. Physical Review 74, p. 200-205, July 15, 1948.

Relativity serves only to predict the relation for those portions of the mass and energy which are dependent upon the velocity. Electromagnetic theory comes near to providing for the rest mass in terms of ordinary electrostatic energy, but with a well known discrepancy amounting to a factor of four-thirds. For uncharged particles electromagnetic theory does nothing. A hypothesis is developed according to which the whole of the rest mass arises from internal motions of the particles in a form consistent with the required behavior of the particles in respect to the apparent forces which they exert. The line of thought is analogous to that of the whole philosophy which sought to see all potential energy as a manifestation of kinetic energy. It has, moreover, the advantage of unifying the concepts of rest energy and kinetic energy in a form which gives the mass-energy relation a more clear cut meaning. The development is carried out along classical lines following the general idea that in seeking ultimately to develop consistent quantum theory in relation to these matters it is good to start by seeking consistent classical representation.

685 New Consequences of the Quantum Theory of Gravitation, by D. Ivanenko and A. Sokolov. Doklady Akademii Nauk SSSR 58, p. 1633, 1947.

686 Non-relativistic Approximation of the Wave Equation of the Meson in a Field of Central Force, by G. Petiau. Journal de Physique et le Radium 8, p. 276-281, September 1947. (In French).

The author gives the form of the wave equation approached by the meson (corpuscular spin = $\frac{h}{2\pi}$) placed in a field of central force when one is limited to a first approximation of the Schrodinger equation, starting with the meson matrix equations or wave equations of de Broglie.

687 A Note on Perturbation Theory, by Eugene Feenberg. Physical Review 74, p. 206-208, July 15, 1948.

The perturbation theory for a stationary state is developed in the form of an implicit equation for the eigenvalue and an explicit equation (involving the eigenvalue) for the amplitudes. With the aid of a formal algebraic identity the equation for the eigenvalue is transformed into a semi-explicit form by a procedure having a wider range of validity than the more obvious iteration or power series processes.

RADIOACTIVITY

688 The Beta Spectrum of $Hg^{203, 205}$, by D. Saxon. AECD - 2121 (ANL-HDY-518), May 24, 1948, decl. July 19, 1948. 6 p. For publication in Physical Review as a Letter to the Editor.

The long-lived $Hg^{203, 205}$ activity has been measured with the 180° beta spectrometer. A comparison of the results of this study with those obtained previously by Friedlander and Wu (Physical Review 63, p. 227, 1943) and Miller and Curtiss (Physical Review 70, p. 983, 1946) is made. The author found a half-life of 43.5 ± 0.5 days, a β-end point of 205 ± 10 Kev, and a γ-ray of 286 ± 5 Kev.

689 The 2.5m Ba Daughter of Cs^{137}, by D. W. Engelkemeir. AECD - 2125 (ANL-4139), April 19, 1948, decl. July 19, 1948. 16 p. For use as a thesis. Document for sale by AEC.

An isomeric state of stable Ba^{137} which decays by γ-emission to the ground state with a half-life of 2.5 minutes has been discovered. This metastable state is formed by β-decay of Cs^{137}. The Ba^{137} γ has an energy of 0.75 Mev and is 13% internally converted giving rise to $\sim$ 0.7 Mev conversion electrons and K X-rays.

690 Determination of the Most Probable Value of Statistical Quantities. Part II, the Average Life of Radioactive Elements, by George Allard. Journal de Physique et le Radium 8, p. 262-269, September 1947. (In French).

The determination of average lives of radioactive elements by means of tests made with counters is discussed. A mathematical development of the subject is presented.

691 Beta- and Gamma-Spectra of Cs^{137}, by J. Townsend, G. E. Owen, Marshall Cleland, and A. L. Hughes. Physical Review 74, p. 99-100, July 1, 1948.

The radiation emitted by Cs^{137} was investigated by means of beta-ray spectrographs. It consists of a simple beta-ray spectrum with an end point of 0.550-Mev and a single gamma ray of 0.663 Mev with 12 per cent of the gamma ray being internally converted. According to the Radioactive Isotope List issued by the Atomic Energy Commission, Cs^{137} emits two groups of beta rays with maximum energies of 0.84 Mev (50 per cent) and 0.5 Mev (50 per cent), and one gamma ray of energy 0.75 Mev. These values were determined by absorption methods. The authors point out that the discrepancy between the two sets of data may be caused by the difficulty in distinguishing by absorption method between a single beta ray group on which an internal conversion line is superposed near the high energy end and two beta ray groups.

RADIOACTIVITY

692 86-Sec Iodine, by C. W. Stanley and S. Katcoff. Chemical Engineering 55, p. 266-268, July 1948. (See also AECD - 1784)

Radioactive iodine produced when uranium undergoes nuclear fission has been found to have a half-life of 86 ± 1 sec. The mass number of 86-second iodine is probably 136.

693 Energy of the Be^7 Gamma-Ray, by Daniel J. Zaffarano, Bernard D. Kern, and Allan C. G. Mitchell. Physical Review 74, p. 105-106, July 1, 1948.

Be^7 formed by the reaction $Li^6(d,n)Be^7$ decays by K-capture to Li^7 either directly to a ground state or to an excited state with the subsequent emission of a gamma ray. The energy of this gamma ray has been measured by several investigators who give values ranging from 453 to 485 Kev. The authors have made a determination of the energy of this gamma ray by means of magnetic lens determinations. They conclude the best value appears to be 474 ± 4 Kev.

694 General Theory of Electronic Disintegrations, by R. Daudel, R. Jacques, M. Jean, J. Ratier, and P. Benoist. Journal de Physique et le Radium 8, p. 257-262, September 1947. (In French).

This first of a series of articles review theories of radioactivity in which electrons, positive or negative, are involved. It gives a general presentation of the phenomenon of electronic disintegration, including classification of the phenomenon, a general development of theory, characteristics of electron capture, characteristics of electron creation, characteristics of β-emission, and conditions under which the different electronic disintegrations occur.

695 On the High Energy Part of the K^{40} β-Spectrum, by S. Franchetti and M. Giovanozzi. Physical Review 74, p. 102-103, July 1, 1948.

The writers investigated the high energy part of the K^{40} β-spectrum with the aid of a cloud chamber and found a value of $(1.7 \pm 0.1) \times 10^6$ ev for the upper limit. A conclusion drawn is that the γ-quantum emitted by K^{40} can be attributed to the β-disintegration of K^{40}. If this is so, a weak band in the β-spectrum with an end point at $(1.7 \pm 0.1 - 1.5) \times 10^6$ ev = $(0.2 \pm 0.1) \times 10^6$ ev is to be expected. Work performed by D. Bocciarelli (Rendiconti dell' Accademia Nazionale dei Lincei 1, p. 1078, 1946) seems to confirm this hypothesis.

696 Shape of the Positron Spectrum of Cu^{61}, by C. Sharp Cook and Lawrence M. Langer. Physical Review 74, p. 227-228, July 15, 1948.

In order to investigate further the large deviation from the Fermi theory of beta decay previously observed in the positron spectrum of Cu^{64}, the momentum distribution of the positrons of Cu^{61} in a high resolution 40-cm radius of curvature shaped field magnetic spectrometer has been studied. As in the case of Cu^{64}, a large deviation from the Fermi theory is observed at low energies. In this case, the excess of positrons appears for all energies below $W = 2.0\ mc^2$.

RADIOCHEMISTRY

697 Effects of Radiation on Aqueous Solutions of Carboxylic Acids, by R. A. Penneman. AECD - 2136 (ANL-HDY-450), 1946, decl. July 21, 1948. 10 p. Informal disposition. Document for sale by AEC.

Irradiation of aqueous solutions of oxalic acid, $(COOH)_2$, with 2.5 Mev X-rays for exposures of $\sim 10^6$ roentgens causes a decrease in the number of both reducing and acid equivalents. Solutions of formic acid, HCOOH, show similar decreases under deuteron and electron irradiation. Approximate values of G (molecules converted per 100 ev) for oxalic acid range from 4 to 6; for formic acid the values are 2.5 for electrons and 1.7 for deuterons.

RADIOGRAPHY

698 A Comparison Study of NTB and Medium Lantern Slide Emulsions for Autoradiographs, by George A. Boyd. AECD - 2106 (UR-33), May 25, 1948, decl. July 9, 1948. 13 p. For publication in Proceedings of the Society for Experimental Biology and Medicine.

The grain speed of Eastman NTB and medium lantern slide emulsions were compared by exposure to a known number of I^{131} beta particles. Grains were counted. On the basis of this work and other unpublished work it appears that an I^{131} beta particle has equal probability for rendering a grain developable in the present NTB emulsions as in the medium lantern slide emulsions even though the latter are larger. The NTB fog is low and resolution high.

699 Radiographic Practice at Ford, by David Goodman. Iron Age 162, p. 90-94, July 22, 1948.

The X-ray techniques used for inspection, process development, applied physics research and other purposes at the Ford Motor Co. are described in this article. The success of radiography in reduction of costs, and the uses of X-ray and electron diffraction in studying surface stresses are also described.

RADIOTHERAPY

700 Direct Infiltration of Radioactive Isotopes as a Means of Delivering Ionizing Radiation to Discrete Tissues, by P. J. Hahn, J. P. B. Goodell, C. W. Sheppard and others. Journal of Laboratory and Clinical Medicine 32, p. 1442, December 1947.

In attempts to radiate the lymphoid macrophage system, manganese dioxide sols were found to be gradually liberated with evidence of secretion by way of the biliary tract. In the case of the gold sols, however, the radioactive material remained in the tissues in which it had been deposited (that is, chiefly the liver and the spleen) for as long as measurements could be made.

A study was made to determine whether the insolubility of gold colloids in body fluids could be used to advantage in direct infiltration of neoplastic fluids. It was found that approximately 40 Vanderbilt units of Au^{198} administered by vein to an adult of average size may result in a remission in chronic

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RADIOTHERAPY

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lymphocytic leukemia. The colloid was administered in the same manner as would be employed for infiltration of a solution of procaine in cases of discrete encapsulated lesions. From a study of clinical cases the authors conclude that direct infiltration of insoluble radioactive colloidal sols of gold is apparently a suitable manner in which to deliver radiation to a discrete mass of tissue.

In one patient with carcinoma of the vagina the tumor mass was such that it could not hold injected fluid and partically all the radioactive colloid leaked out. Another approach to such problems would be the instillation of $Ag^{111}NO_3$, in which the caustic action may tie the agent to the tissue. The possibility of using $AgNO_3$ has been tested in experimental animals by using $Ag^{108,110}$ made by neutron capture in $AgNO_3$. The half-life is 225 days which makes the material unsuitable for human studies.

701 Dosage Determination with Radioactive Isotopes. Part I, Fundamental Dosage Formulae, by L. D. Marinelli, Edith H. Quimby, and G. J. Hine. Nucleonics 2, p. 56-66, April 1948.

It is important to be able to determine the radiation dosage when radioactive isotopes are employed either as tracers or in therapy. In general, this cannot be measured, but when the half-life, radiation energy, and biological uptake and excretion are known, it can be calculated. This paper is divided into two parts, one based on physical and the other (to be published later) on clinical aspects of the problem. In the physical part (Part I) mathematical developments of formulae for dosage rates and total doses for beta- and gamma-ray emitting isotopes, together with subsidiary formulae for safe concentrations are given. Two extensive tables are presented, for beta and gamma rays respectively, giving half-life, average radiation energy, fraction disintegrating per day, and specific dosage data, including the safe tracer concentration for some 38 isotopes.

RARE EARTHS

702 The K Spectra of Element 61, by L. E. Burkhart, W. F. Peed, and E. J. Spitzer. AECD - 2107 (Y-173), May 24, 1948, decl. July 9, 1948. 10 p. For oral presentation before several technical society meetings and for publication in Physical Review.

The K lines of the X-ray spectra of element 61 were obtained on a transmission type spectrograph. The wave length of the lines and the experimental method used are discussed.

703 Artificial Radioactive Isotopes of Cerium and Lanthanum, by James B. Chubbuck. AECD - 2113 (UCRL-109), May 17, 1948, decl. July 19, 1948. 38 p. For use as a thesis and for possible publication in a technical journal.

A description of some bombardments performed with the 60-inch and 184-inch cyclotrons at Berkeley is given. These bombardments resulted in the production of the following isotopes: 19.5 hour La^{135} which decays by orbital electron capture and emits gamma radiation of 0.76 Mev energy; 2.1 hour La^{136}

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which decays by positron emission, the positron having 0.84 Mev energy; La^{137} which has a half-life greater than 400 years; 16 hour Ce^{135} which decays by positron emission; 36 hour Ce^{137} which decays by orbital electron capture emitting conversion electrons of 0.18 Mev energy and gamma radiation of 0.28 and 0.75 Mev energies; and 140 day Ce^{139} which decays by orbital electron capture emitting conversion electrons of 0.15 Mev energy and gamma radiation of 0.18 and 1.8 Mev energies.

704 The Lanthanum and Cerium Isotopes of Mass 137, by M. G. Inghram and D. C. Hess, Jr. AECD - 2115 (ANL-AJD-248), June 15, 1948, decl. July 19, 1948. 2 p. For publication in Physical Review.

The results of a comparison of the isotopic composition of a sample of normal cerium, containing as impurities Ba, La, and Pr, with that of a similar sample submitted to neutron bombardment are reported.

705 Crystal Structures of a Series of Rare Earth Phosphates, by Rose C. L. Mooney. AECD - 2118 (ANL-FWHZ-165), April 3, 1948, decl. July 19, 1948. 6 p. For publication in Acta Crystallographica.

By means of X-ray diffraction studies, it has been found that the phosphates of lanthanum, cerium, praseodymium and neodymium are structurally isomorphous. Two commonly occurring forms exist for each of these compounds. One is a hexagonal structure of a new type, probably stabilized by structural water. The other is monoclinic and isomorphous with the mineral, monazite (La, Ce)PO_4. Structural parameters have been determined for both types.

706 The Isotopic Constitution of Praseodymium and Neodymium, by Mark G. Inghram, David C. Hess, Jr., and Richard J. Hayden. Physical Review 74, p. 98-99, July 1, 1948. (See also MDDC - 1740)

Mass spectrometric measurements of the isotopic constitution of praseodymium and neodymium are reported. Upper limits are set for the existence of some of the rare isotopes. The results for neodymium are compared with those obtained by Mattauch and Hauk based on the photometric analyses of photographic plates.

Isotopic constitution of neodymium.

Observer	142	143	144	145	146	148	150
Mattauch and Hauk	25.95	13.0	22.6	9.2	16.5	6.8	5.95
Inghram and Hess	27.13 ±0.2	12.20 ±0.1	23.87 ±0.2	8.30 ±0.05	17.18 ±0.2	5.72 ±0.06	5.60 ±0.06

RARE EARTHS

707 Thiosulfate Compounds of Some Rare Earths, by D. I. Ryabchikov and V. Ya. Volkova. Doklady Akademii Nauk SSSR 55, p. 505-508, 1947.

Nuclear Science Abstracts supersedes two previous AEC abstract journals, Abstracts of Declassified Documents and Guide to Published Research on Atomic Energy. No copies of the latter journal are available. Back issues of the Abstracts of Declassified Documents may be purchased from the Document Sales Agency.

The indices which appear in each number of Nuclear Science Abstracts will be cumulated for the semi-annual volume.

TRACER APPLICATIONS

708 The Excretion of N^{15} in the Urine of Dogs after the Administration of Labeled Pentobarbital, by H. B. Van Dyke, John V. Scudi, and D. L. Tabern. Journal of Pharmacology and Experimental Therapeutics 90, p. 364-366, 1947.

After the oral administration of Na pentobarbital (Nembutal) labeled with N^{15} dogs excreted about 60 per cent of the total dose of excess N^{15} in the urine during the first 24 hours. The excess N^{15} in the urinary NH_3 and urea represented less than 8 per cent of the N^{15} so that more than 92 per cent was excreted as pentobarbital or metabolic degradation products derived from the drug. In one isotope-dilution experiment, about 3 per cent of the total excess N^{15} in the urine was found to be pentobarbital; this finding confirms the conclusion of other investigators that only minute amounts of pentobarbital are excreted unchanged. Possible structures of the major excretion product or products remain to be considered.

TRACER APPLICATIONS, RADIOACTIVE

709 Distribution of Phosphorus in the Plant Organs in Experiments with Radioactive Isotopes, by V. M. Klechkovski, D. D. Ivanenko, V. B. Bagaev, and V. V. Rachinski. Doklady Akademii Nauk SSSR 58, p. 93-95, 1947.

710 The Effect of Certain Goitrogenic Drugs on the Absorption of Radioactive Iodine by the Thyroid Gland of Rats and Chicks. Part 1, Collection of Radioiodine by Thyroids Made Goitrous Following Chronic Administration of These Agents, by R. W. Rawson, D. A. McGinty, Wendell Peacock, Priscilla Merrill, Mary Wilson and Helen Lockhart. Journal of Pharmacology and Experimental Therapeutics 93, p. 240-245, June 1948.

The capacity of the thyroid gland to collect radioiodine has been studied following chronic treatment of rats and chicks with thiouracil, benzylthiouracil, propylthiouracil, 5-aminothiadiazole-2-thiol (TC-68), 3-(phenylaminomethyl)-thiazolidine-2-thione (TC-105), aminothiazole and potassium thiocyanate. In the rat, thiouracil, TC-68 and TC-105, all highly goitrogenic over the period of treatment, produced effective blocks to the collection of iodine. Aminothiasole was less effective in its blocking action. Goiters produced by KCNS absorb approximately the same amount of injected radioiodine as do thyroids of untreated controls but somewhat less per milligram of thyroid tissue.

In the chick, goiters due to thiouracil and its analogs, benzylthiouracil and propylthiouracil, collect much less iodine than controls. Enlarged thyroids from chronic treatment by aminothiazole, TC-68, TC-105 and KCNS had a greater than normal avidity for radioiodine.

711 The Effect of Certain Goitrogenic Drugs on the Absorption of Radioactive Iodine by the Thyroid Gland. Part II Collection of Radioiodine by Thyroids of Rats and Chicks Following a Single Injection of These Agents, by D. A. McGinty, R. W. Rawson, R. G. Fluharty, Mary Wilson, Charlotte Riddell, and Hilda Yee. Journal of Pharmacology and Experimental Therapeutics 93, p. 246-257, June 1948.

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The antithyroid action of several goitrogenic compounds was studied quantitatively by comparing the effect and duration of effect of varying doses of these agents, when injected subcutaneously, on the collection of radioiodine by the thyroids of rats and chicks. The drugs studied included thiouracil, propylthiouracil, benzylthiouracil, methylthiouracil, 5-aminothiadiazole-2-thiol (TC-68), 3-(phenylaminomethyl)-thiazolidine-2-thione (TC-105), 2-aminothiazole and potassium thiocyanate. In the rat, it was observed that propyl and benzylthiouracil were ten times as effective as thiouracil and methylthiouracil in inhibiting the natural capacity of the thyroid to collect iodine. The duration of inhibitory action of minimal effective doses of these drugs was not materially different. In all cases at least partial escape from the drug effect occurred eight hours after administration.

In the cockrel, the minimal effective inhibitory doses of all compounds were greater than in the rat. Benzylthiouracil was observed to be approximately ten times more effective than thiouracil, propylthiouracil and TC-68. TC-105 aminothiazole and potassium thiocyanate had about one-half the activity of thiouracil. The duration of action of minimal effective doses was six hours. With the exception of aminothiazole, in all instances escape from the block to iodine collection was complete 24 hours after injection of the drug. Certain fundamental differences between the iodine-blocking effect and the goitrogenic action of these agents are discussed.

712 Effects of Vitamin A Deficiency on Thyroid Function Studied with Radioactive Iodine, by Mortimer, B. Lipsett and Richard J. Winzler. Endocrinology 41, p. 494, 1947.

The authors conducted an investigation of thyroid function in severe avitaminosis using I^{131} as a tracer. The experiment indicated that in avitaminosis A there is a decreased rate of formation of thyroxine. The glands of the rat were relatively heavier in the A-deficient group. The histological picture of A avitaminosis appeared as degenerative changes and distended thyroid follicles, both present concomitantly. The total I^{131} uptake was not changed; the inorganic I^{131} in the thyroid reached higher than normal values and decreased more slowly than in the controls.

713 The Fate of Radioactive Copper Administered to the Bovine, by C. L. Comar, George K. Davis, and Leon Singer. Journal of Biological Chemistry 174, p. 905-913, July 1948.

Procedures are described for the use of pile-produced Cu^{64} in studies with large as well as small animals. The results are in general agreement with such findings as are available in the literature. Only a small proportion of orally administered copper is absorbed by the bovine; yet that which is absorbed reaches practically every tissue. Intravenously injected copper is generally distributed and highly retained at least during the first week after administration. Immediately following intravenous injection, copper is rapidly removed from the plasma by the tissues and is more slowly accumulated by the red blood cells. The red blood cell copper is more tenaciously retained than the plasma copper as far as removal by the tissues is concerned, althouth equilibrium between the plasma and red blood cell copper is eventually approached. During the first 1 1/2 months of life the liver of the calf exhibits a greater selective accumulation of absorbed copper than is observed with the older animal. Tissue accumulations of orally administered and intravenously injected copper are presented and discussed.

TRACER APPLICATIONS, RADIOACTIVE

714 Gastic (and Salivary) Excretion of Radioiodine in Man; Preliminary Report, by L. Schiff, C. D. Stevens, W. E. Mollie, H. Steinberg, C. W. Kumpe, and P. Stewart. Journal of the National Cancer Institute 7, p. 349-354, April 1947.

An attempt was made to determine whether the concentrating power of iodine in gastric juice was altered in the presence of gastric disease. The concentration of radioactive iodine was studied in the saliva, gastric juice, blood and urine. Details of the technique are given. The experiments showed that there was a concentration of 20 to 30 times as much radioactivity in the gastric juice and saliva as in serum. There was usually a higher concentration of radioiodine in the saliva than in the gastric juice. Persons with and without pathological processes in the stomach showed no differences.

715 A Note on the Mechanism of Fluoride Fixation, by Marlene Falkenheim and Harold C. Hodge. Journal of Dental Research 26, p. 241-246, 1947.

Fluoride was fixed by the bone when powdered bone samples marked with P^{32} were exposed to neutral aqueous solutions containing fluoride ions. Since no more P^{32} went from bone to solution than was found in the absence of fluoride ions the mechanism of fluoride adsorption probably does not involve exchange with phosphate.

716 Radioactive Tracers; How They can be Used in Flotation Research, by A. M. Gaudin. Engineering and Mining Journal 149, No. 3, p. 53-55, March 1948.

A technique is described which traces the movement of flotation reagents or their ions among several phases or products of a flotation operation. The tracing is accomplished by following the electron-emissions from radioactive atoms that have been synthesized into the flotation reagent. The equipment is illustrated photographically and the procedure is indicated.

717 Riboflavin Enhancement of Radioactive Phosphate Exchange by Yeasts, by Walter J. Nickerson and Lorin J. Mullins. Nature 161, p. 939-940, June 12, 1948.

It has been suggested by von Hevesy that processes occurring at the cell surfaces or just inside cell boundaries play an important part in phosphorus metabolism in yeast. The authors have obtained evidence that they interpret in a similar manner and suggest the existence of a P-complexing factor at the cell surface. It was found possible to increase the radioactive phosphate (P^{32}) exchanged by yeast in the presence of glucose by the addition of trace amounts of riboflavin to the suspending medium. The increases observed range from 20 to 200 per cent over the phosphate exchanged by controls using glucose alone. This effect has been noticed in two widely different species of yeasts. The organisms used were Candida albicans, a pathogenic non-sporulating yeast, and Saccharomyces cerevisia (Carlsberg No. 237). The experiments are described at length.

TRACER APPLICATIONS, RADIOACTIVE

718 The Study of Peripheal Vascular Disease with Radioactive Isotopes, Part I, Daniel C. Elkin, F. W. Cooper, Jr., R. H. Rohrer, W. B. Miller, Jr., Patrick C. Shea, Jr., and E. W. Dennis. Surgery, Gynecology and Obstetrics 87, p. 1-8, 1948.

Two methods for the use of radioactive Na^{24} in the investigation of circulatory physiology of the extremities are compared and discussed. One method involves the "build up" of radioactive sodium in the tissues of the extremities following its intravenous injection in the arm. The second method is a relative flow determination based on the rate of disappearance of radioactive sodium when injected intramuscularly. The results of the second method as applied in a series of normal individuals are evaluated. The apparatus is described in detail. The results obtained using the first method are to be published later.

TRANSURANIC ELEMENTS

719 Investigation of Plutonium Hydride, by J. E. Burke. AECD-2124 (LADC-228), May 16, 1944, decl. July 19, 1948. 3 p. Informal disposition. Document for sale by AEC.

Attempts have been made to prepare plutonium hydride from three different samples of plutonium metal. The first sample did not form an hydride. This report gives the results of the two later attempts. Products corresponded to the following formulas $PuH_{2.55}$ and $PuH_{2.75}$ were obtained.

720 Some Observations on the Basic Chemistry of Plutonium, by E. S. Maxwell. AECD-2134 (LADC-166), October 6, 1944, decl. July 19, 1948. 8 p. Informal disposition. Document for sale by AEC.

On prolonged heating in dilute nitric acid (0.5 M to 6.8 M) a considerable amount of Pu^{+4} is oxidized to Pu^{+6}. Precipitation of the plus three plutonium oxalate is complete in fifteen minutes. Oxidation of PU^{+4} to Pu^{+6} by bromine is quantitative at 105°C after 1/2 hour; at 50°C the rate of oxidation is slow, but measurable. At room temperature the rate is too slow to measure. A method of converting $PuCl_3$ to $Pu(NO_3)_4$ is given. The solubility of $NaPuO_2Ac_3$ increases with temperature, the value at 25°C being 19.5 g/l and that at 95°C, 37.5 g/l. Supersaturation was observed on slow cooling of a saturated solution.

URANIUM

721 The Crystal Structure of $CaUO_4$ and $SrUO_4$, by W. H. Zachariasen. AECD-2139 (CC-2870), April 6, 1945, decl. July 19, 1948. 12 p. For publication in NNES.

The isomorphous compounds $CaUO_4$ and $SrUO_4$ were prepared by adding U_3O_8 to molten $CaCl_2$ or $SrCl_2$. The deduction of the chemical formulas from X-ray diffraction data is described.

$CaUO_4$ and $SrUO_4$ are rhombohedral. The rhombohedral unit cells containing one molecule has dimensions:

$CaUO_4$	6.254 +.001 A	36°2′ ± 1′
$SrUO_4$	6.53 ± .03 A	35°32′ ± 20′

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URANIUM

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The calculated densities are $\rho = 7.45$ for $CaUO_4$ and $\rho = 7.62$ for $SrUO_4$. The space group is R3m and the atomic positions are:

1 U in (000)	$u_1 = 0.110$ for $CaUO_4$
1 Ca(Sr) in (1/2 1/2 1/2)	$u_1 = 0.104$ for $SrUO_4$
2 O_I in $\pm$ ($u_1u_1u_1$),	$u_2 = 0.360$ for $CaUO_4$
	$u_2 = 0.357$ for $SrUO_4$
2 O_{II} in $\pm$ ($u_2u_2u_2$),	

There are uranyl groups in the structure. These are linear groups O_I-U-O_I with U-O_I = 1.91 $\pm$ .12 A. Each uranium forms six additional bonds with U-O_{II} = 2.30 $\pm$ .03 A. The structure can be described as a stack of identical layers of average composition $(UO_4)^{-2}$ held together by calcium or strontium atoms. It is pointed out that such $(UO_4)^{-2}$ layers are present in many other uranates.

In order to obtain more information about the crystal chemistry of hexavalent uranium compounds, this writer has prepared a number of uranates and studied their crystal structures. This article gives an account of the investigations carried out on calcium uranate and the isomorphous strontium uranate.

722 The Crystal Structure of Uranyl Fluoride, UO_2F_2, by W. H. Zachariasen. AECD-2140 (ANL-FWHZ-162), September 1, 1946, decl. July 19, 1948. 13 p. For publication in the NNES.

The ideal structure of UO_2F_2 is rhombohedral. The rhombohedral unit cell contains one molecule and has dimensions a = 5.764 $\pm$ 0.001 A, $\alpha = 42° 43' \pm 3'$. The calculated density is $\rho = 6.365$. The space group is R3m and the atomic positions are: 1 U in (000), 2 O in $\pm$ (uuu) with u = 0.122, 2 F in $\pm$ (vvv) with v = 0.370.

Each uranium atom is bonded to two oxygen atoms with U-O = 1.91 A and to six fluorine atoms with U-F = 2.48 A. The ideal structure is a typical example of a layer structure. The layers are normal to the three-fold axis and 5.230 A apart. The axis of the uranyl group is normal to the plane of the layers. The actual structure of UO_2F_2 shows stacking disorder, the degree of disorder depending upon the thermal history of the sample. The detailed nature of the disorder is deduced.

723 Crystal Structure Studies of Sulfides and Oxy-Sulfides of Uranium, Thorium, and Cerium, by W. H. Zachariasen. AECD-2141 (ANL-FWHZ-161), September 1, 1946, decl. July 19, 1948. 24 p. For publication in NNES.

In the U-S system, the compounds US, U_2S_3, and US_2 have been observed; in the Th-S system the compounds ThS; Th_2S_3, Th_7S_{12} and ThS_2. In the Ce-S system there are the phases CeS and Ce_3S_4. The latter phase has a wide homogenity range extending from Ce_3S_4 to Ce_2S_3. The oxysulfides UOS, ThOS, and Ce_2O_2S have been observed.

The compounds US, ThS, and CeS have the NaCl-type of structure. The Ce_3S_4-structure represents a new structure type which is cubic with four molecules per unit cell. U_2S_3 and Th_2S_3 have the Sb_2S_3-type structure. The compound Th_7S_{12} is hexagonal or pseudohexagonal. ThS_2 has the $PbCl_2$-type of structure and one form of US_2 may be isomorphous. The usual form of US_2 is tetragonal.

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URANIUM

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UOS and ThOS have the PbFCl-type of structure. Ce_2O_2S is hexagonal and with a structure closely related to that of Ce_2O_3. Detailed data are given regarding the crystalline structure and characteristics of several of the sulfides and oxysulfides of uranium, thorium, cerium and lanthanum.

724 Oxidation of Uranium Dioxide (UO_2), by Fredirk Gronvold and Haakon Haraldsen. Nature 162, p. 69-70, July 10, 1948.

UO_2 was heated in purified oxygen at temperatures ranging from 100° to 265°C and the various oxidation products examined by the powder X-ray diffraction method. The results are tabulated and discussed.

725 The Presence In Nature of Certain Stable Products of the Spontaneous Disintegration of Uranium, by V. G. Khlopin, E. K. Gerling, and N. V. Baranovskaya. Izvestiya Akademii Nauk SSSR, Otdelenie Khimicheskikh Nauk, November-December 1947, p. 599-604. (In Russian).

A formula is proposed for determining the absolute age of uranium containing minerals. It is based on the uranium and the xenon content of uranium ores. An assumption is that all isotopes of uranium undergo spontaneous disintegration. A description and diagram of the apparatus for determining the xenon content is included. The application of the formula to uranite from a pegmatite vein of North Karelia is described. 12 references are given.

726 The Uraninites, by Ruth Bakken, Ellen Gleditsch and A. C. Pappas. Bulletin de la Société Chimique de France 1948, p. 515-517, May-June 1948. (In French)

Research on the uraninites led to a study of the ratio U^{+4}/U^{+6} betweem quadrivalent and hexavalent uranium. When uraninite minerals are heated in an atmosphere of argon the ratio UO_2/UO_3 increases showing UO_3 decomposes easily on heating to give UO_2 and oxygen.

X-RAYS

727 Correction Factors in the Measurement of Diffusion of X Rays at Small Angles, by A. Guinier and G. Fournet. Journal de Physique et le Radium 8, p. 345-351, December 1947. (In French).

In experiments on diffusion of X rays at small angles, the beam is generally limited by slits instead of fine holes. This arrangement has the effect of modifying the variation with the angle of diffused intensity. The importance of this effect is calculated for specific cases. A general method of correction, and several applications of it are given.